INTERNATIONAL JOURNAL OF PRODUCTION RESEARCH

CONTENTS

Volume 28, 1990

International Journal of Production Research

Editor

Professor Roy J. Sury, Ph.D., C.Eng.
Department of Manufacturing Engineering, Loughborough University of Technology
Leicestershire LE11 3TU, U.K.

Associate Editor

John E. Middle, M.Sc., C. Eng.
Department of Manufacturing Engineering
Loughborough University of Technology

Reviews Editor

Geoffrey F. Modlen, Ph.D., C.Eng.
Department of Manufacturing Engineering
Loughborough University of Technology

Editorial Board

Australia:	Dr. B. W. Jenney, Chisholm Institute of Technology, Victoria.
Canada:	Professor A. K. S. Jardine, University of Toronto.
	Professor M. Osman, Concordia University, Quebec.
Denmark:	Professor C. H. Gudnason, Danmarks Tekniske, Højskole, København.
France:	Professor G. Doumeingts, University of Bordeaux.
F.R. Germany:	Professor Dr.-Ing. H. Bullinger, Fraunhofer-IAO, Stuttgart.
	Professor Dr.-Ing. W. Laurig, Institut fur Arbeitsphysiologie, Dortmund.
	Professor Dr.-Ing. H. J. Warnecke, Fraunhofer-IPA, Stuttgart.
Hong Kong:	Professor N. N. S. Chen, University of Hong Kong.
Holland:	Professor W. Bakker, Twente University of Technology, Enschede.
Hungary:	Professor Dr. F. J. Lettner, Budapest Müszaki Egyetem, Gépipari Technológiai Tanszék, Budapest IX.
India:	Professor N. K. Tewari, Indian Institute of Technology, New Delhi.
Israel:	Professor E. Dar-El, Technion-Israel Institute of Technology, Haifa.
Japan:	Professor Y. Furukawa, Tokyo Metropolitan University, Tokyo.
	Professor K. Hitomi, P. E., Kyoto University/Beijing Institute of Technology· Southwestern Jiaotong University (China).
	Professor R. Muramatsu, Waseda University, Tokyo 160.
Singapore:	Professor S. K. Leung, Nanyang Technological Institute.
Sweden:	Professor S. Axsäter, Luleå University of Technology.
United Kingdom:	Professor R. Bell, Loughborough University of Technology.
	Professor J. Burbidge, Cranfield Institute of Technology, Bedford.
	Professor J. Parnaby, Lucas Industries, Solihull.
U.S.A.:	Professor G. Boothroyd, University of Massachusetts, Amherst.
	Professor N. Gaither, Texas A & M University, College Station.
	Dr. S. B. Gershwin, Massachusetts Institute of Technology, Cambridge.
	Professor K. Knott, The Pennsylvania State University.
	Professor E. Koenigsberg, University of California, Berkeley.
	Professor A. Kusiak, The University of Iowa.
	Professor A. Mital, University of Cincinnati, Ohio.
	Professor C. Moodie, Purdue University, West Lafayette, Indiana.
Yugoslavia:	Professor D. Zelenović, University of Novi Sad.
Founding Editor:	Professor N. A. Dudley, Emeritus Professor, University of Birmingham, U.K.

Subscription Information

International Journal of Production Research (ISSN 0020-7543) is published monthly by Taylor & Francis Ltd, 4 John Street, London WC1N 2ET, UK.

Annual Subscription 1991 £390, US $670.

Personal subscription 1991 to members of the Institution of Production Engineers: £55, US$115. Personal subscriptions must be paid by personal cheque or credit card.

Second class postage paid at Jamaica, New York 11431. USA Postmasters: Send address changes to *International Journal of Production Research*, Publications Expediting Inc., 200 Meacham Avenue, Elmont, NY 11003. Air freight and mailing in the USA by Publications Expediting Inc., 200 Meacham Avenue, Elmont, NY 11003.

Printed in UK by Burgess Science Press, Rankine Road, Basingstoke, Hampshire RG24 0PR, UK. The paper used in this publication is 'acid-free' and conforms to the American National Standards Institute requirements in this respect.

Dollar rates apply to subscribers in all countries except the UK and the Republic of Ireland where the pound sterling price applies. All subscriptions are payable in advance and all rates include postage. Journals are sent by air to the USA, Canada, Mexico, India, Japan and Australasia. Subscriptions are entered on an annual basis, i.e. January to December. Payment may be made by sterling cheque, dollar cheque, international money order, National Giro, or credit card (Amex, Visa, Mastercard/Access).

Orders originating in the following territories should be sent direct to the local distributor. **Australia:** R. Hill & Son Ltd, 117 Wellington Street, Windsor, Victoria 3181. **New Zealand:** R. Hill & Son Ltd, Private Bag, Newmarket, Auckland 1. **India:** Universal Subscription Agency Pvt. Ltd, 101–102 Community Centre, Malviya Nagar Extn, Post Bag No. 8, Saket, New Delhi 110017. **Japan:** Kinokuniya Company Ltd, Journal Department, PO Box 55, Chitose, Tokyo 156. **USA, Canada and Mexico:** Taylor & Francis, Inc., 1900 Frost Road, Suite 101, Bristol, PA 19007. **UK and all other territories:** Taylor & Francis Ltd, Rankine Road, Basingstoke, Hampshire RG24 0PR.

Advertisements

All enquiries to Taylor & Francis Ltd, Basingstoke (0256) 840366 or Taylor & Francis New York Inc (212) 725 19999.

Copyright © 1990 The Institution of Production Engineers

International Journal of Production Research

VOLUME 28, 1990—CONTENTS

No. 1 January 1990 PAGE

A mathematical programming approach for determining workcentre lotsizes in a just-in-time system with signal Kanbans. P. R. PHILIPOOM, L. P. REES, B. W. TAYLOR, III and P. Y. HUANG... 1

Deliberately slowing down output in a family production context. E. A. SILVER 17

A break-even quality level approach to location of inspection stations in a multi-state production process. M. BARAD... 29

Multi-criteria operational control rules in flexible manufacturing systems (FMSs). IN-KYO RO and JOONG-IN KIM 47

Schedule generation in a dynamic job shop. YIH-LONG CHANG and R. S. SULLIVAN.. 65

The application of inverse kinematics in the optimum sequencing of robot tasks. L. L. ABDEL-MALEK and ZHIMING LI.. 75

Manufacturing systems with forbidden early shipment: implications for choice of scheduling rules. D. P. CHRISTY and J. J. KANET 91

A general mathematical model for optimizing NC tool path for face milling of flat convex polygonal surfaces. P. V. PRABHU, A. K. GRAMOPADHYE and HSU-PIN (BEN) WANG 101

The key issues of a quality improvement process. D. M. LASCELLES and B. G. DALE 131

An assignment model for the part-families problem in group technology. G. SRINIVASAN, T. T. NARENDRAN and B. MAHADEVAN 145

Reasoning about machining operations using feature-based models. A. H. JURI, A. SAIA and A. DE PENNINGTON... 153

Interaction effects on MRP nervousness. J. R. MINIFIE and R. A. DAVIS ... 173

An efficient heuristic in manufacturing cell formation for group technology applications. G. HARHALAKIS, R. NAGI and J. M. PROTH 185

Setup cost reduction in an inventory model with finite-range stochastic lead times. F. NASRI, J. F. AFFISCO and M. J. PAKNEJAD. 199

Book reviews 213

Corrigendum 221

Announcement 222

No. 2 February 1990 PAGE

Economic group testing. S. OGAWA and H. OHTA 223

Grouping efficacy: a quantitative criterion for goodness of block diagonal forms of binary matrices in group technology. C. S. KUMAR and M. P. CHANDRASEKHARAN 233

Optimal nondelay job shop schedules. J. HUTCHISON and Y.-L. CHANG ... 245

Economic design of a complete inspection plan for bivariate products. YER VAN HUI 259

Methods of improving subjective measurement by a single judge. P. K. AGRAWAL 267

PRICAPP: A computer assisted process planning system for prismatic components. S. S. PANDE and M. G. WALVEKAR 279

A simulation study on performance improvement of group technology cells. F. SASSANI 293

Fast evaluation of an unreliable transfer line with limited transportation devices. G. ACHARD and J. M. PROTH 301

Dynamic layout strategies for flexible manufacturing systems. P. AFENTAKIS, R. A. MILLEN and M. M. SOLOMON 311

Designing flexible manufacturing cells using a branch and bound method. I. AL-QATTAN 325

Optimal utilization of a finite capacity integrated assembly system. B. POURBABAI 337

Machining and material flow system design for minimum cost production. P. J. EGBELU 353

The look ahead dispatching procedure. M. J. ZEESTRATEN 369

Adjustment rules based on quality control charts. W. D. KELTON, W. M. HANCOCK and D. P. BISCHAK... 385

Computationally efficient approximations for balanced flowlines with finite intermediate buffers. A. G. DE KOK 401

Do not forget the breakdowns and the maintenance operations in FMS design problems! M. WIDMER and P. SOLOT 421

Book reviews 431

No. 3 March 1990

Towards an adaptive Kanban system. A. CHAUDHURY and A. B. WHINSTON 437

Design parameters selection and ordering of part-orienting devices. B. JAUMARD, SHI-HUI-LU and C. SRISKANDARAJAH... 459

On the construction of control charts using linguistic variables. JYH-HONE WANG and TZVI RAZ 477

PAGE

Machine assignments in production systems with manufacturing cells. E. A. ELSAYED and T. Y. KAO 489

Operation routeing with lot sizing consideration in a manufacturing system. P. J. EGBELU and A. LEHTIHET 503

Feature reasoning for automatic robotic assembly and machining in polyhedral representation. B. O. NNAJI and HSU-CHANG LIU 517

Master production scheduling make-to-stock products: a framework for analysis. V. SRIDHARAN and W. L. BERRY 541

The system generator concept for FMS research and analysis. C. M. HARMONOSKY and R. P. SADOWSKI 559

Material flow management in cellular configurations for small-lot, circuit card assembly. T. H. ROCKWELL JR and W. E. WILHELM 573

Statistical quality control for correlated samples. KAI YANG and W. M. HANCOCK 595

Book reviews 609

Announcement 613

No. 4 April 1990

Machine layout: an optimization and knowledge-based approach. S. S. HERAGU and A. KUSIAK 615

A model and a solution approach for the machine loading and tool allocation problem in a flexible manufacturing system. B. RAM, S. SARIN and C. S. CHEN 637

Automatic detection of wear and chipping of cutting tools by image processing techniques. H. YAMASHINA, S. OKUMURA and H. KUMAMOTO 647

A comparison of selected manufacturing cell formation techniques. S. M. SHAFER and J. R. MEREDITH 661

Input adaptive strategy: Formulation, development and application of a functional manufacturing strategy. R. C. BARKER 675

An integrated approach to facilities layout using expert systems. G. ABDOU and S. P. DUTTA 685

A practical heuristic for the group technology economic lot scheduling problem. HSIU-WEI KUO and R. R. INMAN 709

A procedure for scheduling punch presses with restrictions on the sequence of punches. W. S. SHIN, S. F. BULLINGTON and D. W. CAUSEY 723

An expert system based controller for an automated storage/retrieval system. R. J. LINN and R. A. WYSK 735

An analytical method for configuring fixed-path, closed-loop material handling systems. G. P. SHARP and FUH-HWA FRANKLIN LIU 757

PAGE

Analysis of scheduling rules for an FMS. M. MONTAZERI and L. N. VAN WASSENHOVE 785

Book reviews 803

No. 5 May 1990

Design optimization of industrial robots considering the working environment. M. YOSHIMURA, N. YOSHIKAWA and K. HITOMI, P. E. ... 805

Abandoning the moving assembly line: models of human operators and job sequencing. J. A. BUZACOTT 821

Optimal tool inspection intervals using a process control approach. S. O. SCHALL and M. J. CHANDRA 841

Quality assurance and stage dynamics in multi-stage manufacturing. Part I. W. G. FERRELL and S. E. ELMAGHRABY 853

CONWIP: a pull alternative to kanban. M. L. SPEARMAN, D. L. WOODRUFF and W. J. HOPP 879

A multiobjective evaluation of flexible manufacturing system loading heuristics. YUNG-JUNG CHEN and R. G. ASKIN 895

A workload based model for minimizing total intercell and intracell moves in cellular manufacturing. R. LOGENDRAN 913

Guide path design and location of load pick-up/drop-off points for an automated guided vehicle system. W. G. GOETZ, JR and P. J. EGBELU ... 927

An expert system for designing precision forging dies. SHU-CHUN WANG and JIANG CHEN 943

A comparison of dispatching rules for job shops with multiple identical jobs and alternative routeings. YEONG-DAE KIM 953

The good, the bad and the ugly: Quality on an assembly line. L. W. ROBINSON, J. O. MCCLAIN and L. J. THOMAS 963

A rules-based scheduling system for flow type assembly. C. COPAS and J. BROWNE 981

Book reviews 1007

No. 6 June 1990

Failure diagnosis of a servovalve by neural networks with new learning algorithm and structure analysis. H. YAMASHINA, H. KUMAMOTO, S. OKUMURA and T. IKESAKI 1009

Optimal flow path design of unidirectional AGV systems. M. KASPI and J. M. A. TANCHOCO 1023

PAGE

Detecting electrical shorts on printed circuit boards. S. C. FANG 1031

Grouping parts and tools in flexible manufacturing systems production planning. J. A. VENTURA, F. F. CHEN and C.-H. WU 1039

Experimental modelling and optimization of turning medium carbon steel. G. A. HASSAN and S. M. A. SULIMAN 1057

A physical system theory framework for modelling manufacturing systems. N. SINGH and SUSHIL 1067

Quality assurance and stage dynamics in multi-stage manufacturing. Part II. S. E. ELMAGHRABY and W. G. FERRELL 1083

The state of JIT implementation and development in the USA. J. P. GILBERT 1099

A low cost artificial intelligence vision system for piece part recognition and orientation. D. J. M. ELLIOTT and B. J. GRIFFITHS 1111

Coordination of replenishment activities. K. ZOLLER 1123

An assembly chart oriented assembly line balancing approach. A. SHTUB and E. M. DAR-EL 1137

Analysis of optimal machining conditions for flow-type automated manufacturing systems: maximum efficiency for multi-product production. K. HITOMI 1153

A simple formula for estimating throughput of serial production lines with variable processing times and limited buffer capacity. D. E. BLUMENFELD 1163

Quantifying opportunity costs associated with adding manufacturing flexibility. Y. K. SON and C. S. PARK 1183

The analysis of repetitive sequencing at the workcell level: from workcell tasks to workcell cycles. P. FREEDMAN and R. ALAMI 1195

Discussion. A note on 'A closed form solution for the $G/M/r$ machine interference model' by B. D. Bunday and E. Khorram. G. BIAGINI and M. E. GOLDFEDER 1215

Discussion. The efficiency of unbalancing production lines: an alternative interpretation. T. L. SMUNT and W. C. PERKINS 1219

Discussion. On the efficiency of unbalancing production lines: a reply to an alternative interpretation. K. C. SO 1221

Announcement 1223

No. 7 July 1990

Concurrent design and economic justification in developing a product. J. S. NOBLE and J. M. A. TANCHOCO 1225

A simplified procedure for the economic design of $\bar{X}$-charts. KUN-JEN CHUNG 1239

Production data based similarity coefficient for machine-component grouping decisions in the design of a cellular manufacturing system. T. GUPTA and H. SEIFODDINI 1247

PAGE

On-line loading and dispatching in flexible manufacturing systems. M. GARETTI, A. POZZETTI and A. BAREGGI 1271

A service-level-oriented heuristic approach to production planning in a robotized spinning-mill. P. LEFRANÇOIS and Y. ALIE 1293

Development of cost model for the single-model stochastic assembly line balancing problem. S. C. SARIN and E. EREL 1305

Part assignment to electronic insertion machines: two machine case. D. BEN-ARIEH and M. DROR 1317

Sufficient statistics process control: An empirical Bayes approach to process control. G. W. STURM, S. A. MELNYK, C. A. FELTZ and J. F. WOLTER 1329

Joint consideration of grouping and loading problems in a flexible manufacturing system. P. KUMAR, N. K. TEWARI and N. SINGH 1345

Optimal cutting tool replacement based on tool wear status. CHEN ZHOU, J. CHANDRA and R. WYSK 1357

Analysis of material flow in a job shop with assembly operations. T. C. E. CHENG 1369

AGV-served assembly lines: influence of sequencing and launch policies on system performances. V. GRASSO 1385

No. 8 August 1990

A methodology for recognizing features in two-dimensional cylindrical part designs. A. SAHAY, G. R. GRAVES, C. M. PARKS and L. MANN, JR ... 1401

A comparison of three array-based clustering techniques for manufacturing cell formation. CHAO-HSIEN CHU and MAYSHING TSAI 1417

Measuring total productivity using production functions. A. GHOBADIAN and T. HUSBAND 1435

An economic model for determining the optimal quality and process control policy in a queue-like production system. LIE-FERN HSU and C. S. TAPIERO 1447

Value function approximation via linear programming for FMS scheduling. R. AKELLA, O. MAIMON and S. B. GERSHWIN 1459

A mixed-integer programming approach to the machine loading and process planning problem in a process layout environment. MING LIANG and S. P. DUTTA 1471

A heuristic for assigning facilities to locations to minimize WIP travel distance in a linear facility. A. HOUSHYAR and L. F. MCGINNIS 1485

Development of a knowledge-based system for dynamic scheduling. S. C. SARIN and R. R. SALGAME 1499

The solid modelling of part orienting tracks for automated assembly. E. K. LO and M. D. DICK 1513

PAGE

Process plan selection. K. BHASKARAN 1527

Integrated design of cellular manufacturing systems in the presence of alternative process plans. D. RAJAMANI, N. SINGH and Y. P. ANEJA ... 1541

A graph partitioning procedure for machine assignment and cell formation in group technology. R. G. ASKIN and KUOHUNG SIMON CHIU 1555

Book reviews 1573

No. 9 September 1990

Design and performance evaluation of closed automatic assembly systems. C. M. LIU and J. M. CHIOU 1577

Job shop scheduling with alternative machines. N. NASR and E. A. ELSAYED 1595

Design of an automated guided vehicle-based material handling system for a flexible manufacturing system. B. MAHADEVAN and T. T. NARENDRAN... 1611

Discrete cell control. I. T. FRANKS, M. LOFTUS and N. T. A. WOOD ... 1623

The quasi-simultaneous finishing of work orders on a flexible automated manufacturing cell in a job shop. C. W. G. M. DIRNE 1635

Towards an integrated evaluation of flexible automation investments. N. C. SURESH 1657

A knowledge based approach for automatic process plan generation in an electronic assembly environment. V. M. IRIZARRY-GASKINS and T.-C. CHENG 1673

An investigation of dynamic group scheduling heuristics in a job shop manufacturing cell. F. MAHMOODI, K. J. DOOLEY and P. J. STARR ... 1695

SmartSim: An object oriented simulation program generator for manufacturing systems. O. M. ÜLGEN and T. THOMASMA 1713

Technical note. The performance of push and pull systems: a corrected analysis. K. R. BAKER, S. G. POWELL and D. F. PYKE 1731

Corrigendum 1737

Announcement 1738

Book reviews 1739

No. 10 October 1990

A model for the design of zone control automated guided vehicle systems. C. J. MALMBORG 1741

An experimental investigation into the influence of ZrN and TiN coatings on drills in drilling Hasteloy. S. CHANDRASHEKHAR, S. CHATTERJEE and M. GAISER 1759

PAGE

Part-period balancing with uncertainty: a fuzzy sets theory approach. Y. Y. LEE, B. A. KRAMER and C. L. HWANG 1771

Travel-time models considering the operating characteristics of the storage and retrieval machine. HARK HWANG and SEONG BEAK LEE 1779

Metamodels of production line transient behaviour for sudden machine breakdowns. LI LIN and J. K. COCHRAN 1791

Assembly line balancing: a set of challenging problems. T. R. HOFFMANN 1807

On the Srikar-Ghosh MILP model for the $N \times M$ SDST flowshop problem. E. F. STAFFORD JR and FAN T. TSENG 1817

Adoption of an organizational innovation: total quality control in industrial firms. J. N. BLAUW and W. E. DURING 1831

Part-mix allocation between automated and conventional manufacturing. M. SINAN KAYALIGIL 1847

Tool wear monitoring using acoustic emission in the existence of chatter. YOICHI MATSUMOTO, NGUN TJIANG, B. FOOTE and YNGVE NAERHEIM 1861

A heuristic algorithm for loading new work on circuit pack assembly lines. P. K. JOHRI 1871

Concurrent engineering: decomposition and scheduling of design activities. A. KUSIAK and K. PARK 1883

Expert system rules for fixture design. A. R. DARVISHI and K. F. GILL ... 1901

No. 11 November 1990

A quantitative comparison of production and inventory control concepts. P. E. T. STRIEKWOLD 1921

Using Taguchi design, regression analysis and simulation to study maintenance float systems. M. N. CHANIN, C.-H. KUEI and C. LIN 1939

Repair policies for additively degrading machines. J. B. GOLDBERG and E. A. SMITH 1955

A minimum trajectory for machine tool dynamics. M. A. RAHBARY and G. N. BLOUNT 1977

A due date-based dispatching rule for flexible manufacturing systems. S. P. STOEVA 1991

Economic design of $\bar{X}$-bar control charts for use in monitoring continuous flow processes. T.-Y. KOO and K. E. CASE 2001

FMS Designer: An expert system for flexible manufacturing system design. J. M. MELLICHAMP, O-J. KWON and A. F. A. WAHAB 2013

Designing performance measurement systems for just-in-time operations. K. M. CRAWFORD and J. F. COX 2025

PAGE

Design of a scheduling system for flexible manufacturing cells. D.-Y. CHAN and D. D. BEDWORTH 2037

A simultaneous-mounting process for automated printed circuit board assembly. C.-M. CHANG and L. YOUNG 2051

Investigations into reaming processes using a frequency-decomposition technique. M. S. SHUNMUGAM and G. SOMASUNDARAM 2065

A network approach to cell formation in cellular manufacturing. T. VOHRA, D.-S. CHEN, J. C. CHANG and H.-C. CHEN 2075

Flowshop sequencing problems with limited buffer storage. R. LEISTEN ... 2085

Determining the number of kanbans: a step toward non-stock-production. H. WANG and H.-P. WANG 2101

An examination of routeing flexibility for small batch assembly of printed circuit boards. D. TAYLOR and R. J. GRAVES 2117

Route selection and flow control in a multi-stage manufacturing system with heterogeneous machines within stages. P. J. EGBELU 2137

No. 12 December 1990

Off-line adaptive optimization of CNC lathe turning. E. H. T. WEE, A. Y. C. NEE and T. N. GOH 2157

A methodical approach to the flexible-manufacturing-system batching, loading and tool configuration problems. H. C. CO, J. S. BIERMANN and S. K. CHEN 2171

Job-shop scheduling: limits of the binary disjunctive formulation. K. P. WHITE, JR and R. V. ROGERS 2187

Real time process monitoring and adaptive control during CNC deep hole drilling. Y. KAVARATZIS and J. D. MAIDEN 2201

Quality control in a single state production system: open and closed loop policies. D. N. P. MURTHY and I. DJAMALUDIN 2219

Multiple routeings and capacity considerations in group technology applications. R. NAGI, G. HARHALAKIS and J.-M. PROTH 2243

Development of a knowledge-based decision support system for diagnosing malfunctions of advanced production equipment. N. NARUO, M. LEHTO and G. SALVENDY. 2259

Two new rules to minimize tardiness in a job shop. E. J. ANDERSON and J. C. NYIRENDA 2277

The impact of buffering strategies on the performance of production line systems. K. C. SO 2293

Imposing precedence constraints on NC punch press sequences. J. A. SVESTKA 2309

PAGE

The inventory costs of common mis-specification of demand-forecasting models. R. D. BADINELLI 2321

Economic design of multi-characteristic models for a three-class screening procedure. Y. LO and K. TANG 2341

A CAD/CAM system from 3D coordinate measuring data. A.-C. LEE, D.-P. CHEN and C.-L. LIN 2353

A sensor-based accelerated approach for multi-attribute machinability and tool life evaluation. B. MALAKOOTI, J. WANG and E. C. TANDLER 2373

Comparing manufacturing and control practices in Europe and Korea. B.-H. RHO and D. C. WHYBARK 2393

Referees 1989/90 2405

Index of Authors (with titles) 2413